

Endobronchial sand casts: an unusual marker of saltwater immersion in a juvenile pygmy sperm whale (*Kogia breviceps*)

Roger W. Byard · Aaron J. Machado ·
David McLelland

Accepted: 24 August 2010
© Springer Science+Business Media, LLC 2010

Case report

A juvenile pygmy sperm whale (*Kogia breviceps*) was found wedged among rocks at a beach near Adelaide, South Australia. It was alive but bleeding from injuries to the ventral surface and flanks. The animal was freed but despite numerous attempts by onlookers to guide it back to sea the whale was not able to swim normally, and each time floated back into shallow waters, rolling over in the one meter high waves. Representatives of the Australian Marine Wildlife Research and Rescue Organization were called and, given the condition of the whale, a decision was made to euthanize it with an intravenous injection of pentobarbitone.

A necropsy was performed later that day at the Royal Zoological Society of South Australia. At that time the animal was observed to be a well-nourished juvenile male pygmy sperm whale (*Kogia breviceps*) (length 1.85 m, weight 92.8 kg; dorsal blubber thickness 30 mm) (Fig. 1). The only external signs of injury were multiple linear abrasions with superficial epidermal loss associated with the recent wedging among rocks. Radiological examination did not reveal any projectiles and internal examination did

not identify any underlying natural diseases that could have caused or contributed to death. There was no evidence of infection on microbiological workup of blood, urine, and feces.

The most significant findings were a thin (1 mm thickness) extradural hematoma in the posterior occipital region not associated with skull fracture. Although there was no overlying bruising, there were extensive areas of superficial abrasion around the head and lower jaw. There were no specific or patterned injuries to the head to suggest that there had been impact from a blunt object. Also present on microscopy was posterior cerebellar subarachnoid hemorrhage (Fig. 2) with focal areas of intraparenchymal hemorrhage in the upper cervical cord. A very early vital reaction was present in the extradural hematoma. There



Fig. 1 A well-nourished juvenile pygmy sperm whale (*Kogia breviceps*) with superficial linear abrasions of the head from wedging among rocks

R. W. Byard (✉)
Discipline of Anatomy and Pathology, The University
of Adelaide, Level 3 Medical School North Building,
Frome Road, Adelaide, SA 5005, Australia
e-mail: roger.byard@sa.gov.au

A. J. Machado
Australian Marine Wildlife Research and Rescue Organization,
Torrens Island, SA, Australia

D. McLelland
Royal Zoological Society of South Australia, Adelaide,
SA, Australia

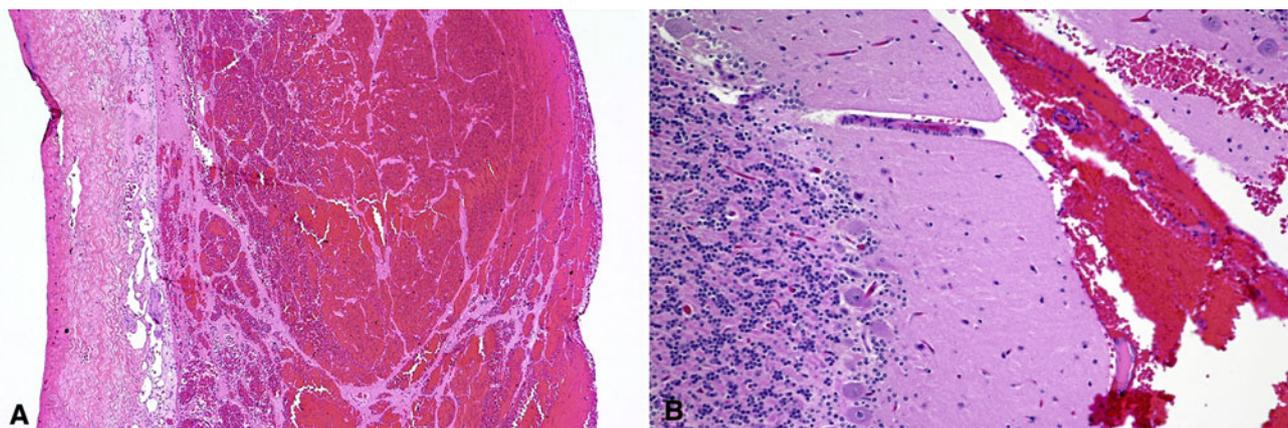


Fig. 2 Microscopic section of posterior occipital extradural hematoma (a) with associated posterior cerebellar subarachnoid hemorrhage (Hematoxylin and eosin, $\times 80$; $\times 120$)

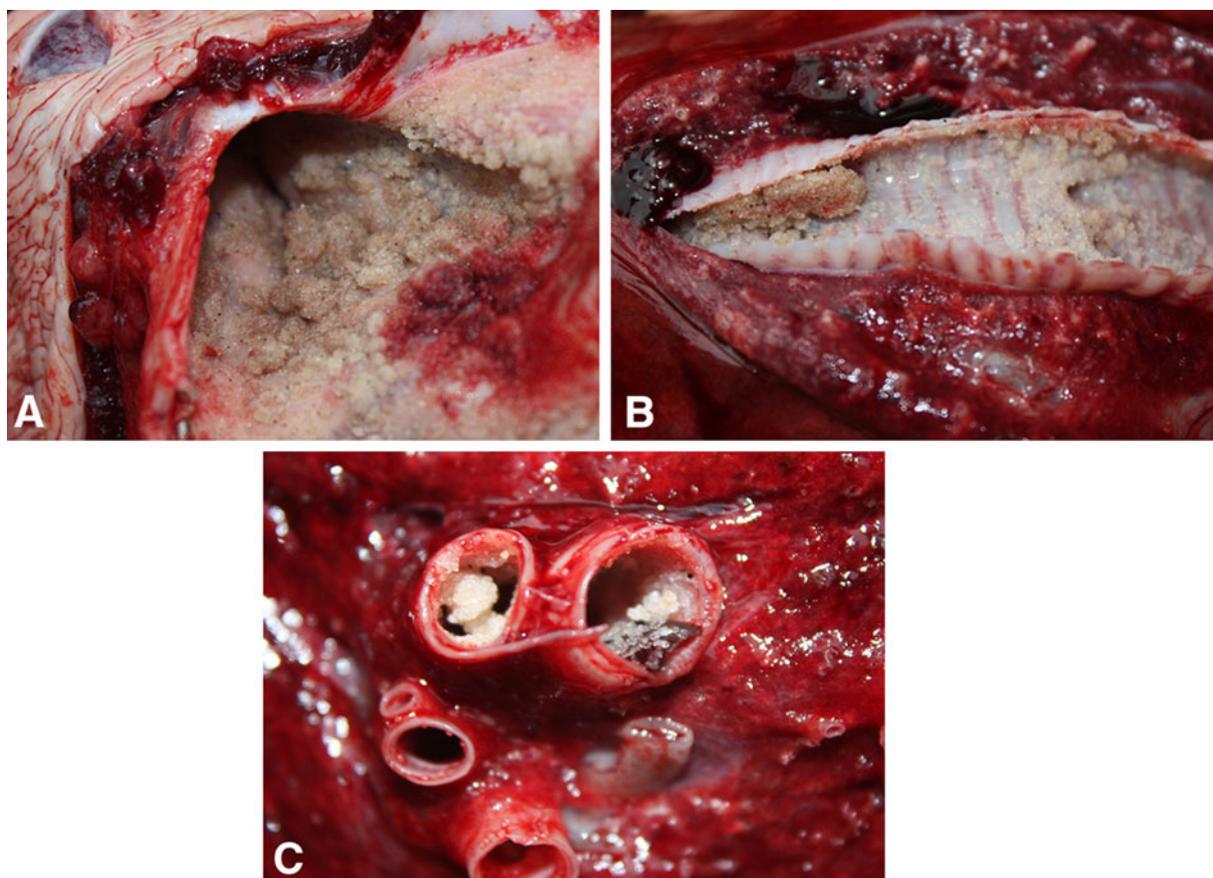


Fig. 3 Aggregated collections of sand within the upper trachea (a) with an impacted sand cast in a smaller bronchiole (b) and in the distal airways in association with inhaled fragments of seaweed (c)

was no evidence of encephalitis or other infection, and no acute hypoxic-ischemic change.

Of note, the lungs showed marked congestion and edema with extensive, and on occasion impacted, sand casts present within the airways extending from the

blowhole through the trachea to the distal bronchioles (Fig. 3). Histological examination of tissues was otherwise unremarkable.

Death was, therefore, due to barbiturate euthanasia in an animal that had suffered blunt head trauma following

stranding and wedging among rocks. The most likely scenario involved the animal sustaining concussive head injuries before or after wedging that interfered with its subsequent ability to swim. This resulted in tumbling in the surf with inhalation of salt water laden with suspended sand. Filling of the smaller airways and larger with extensive sand casts would have meant that survival would not have been possible, even if the animal had been able to recover from the trauma of wedging and head injury.

Discussion

Pygmy sperm whales are among the smallest members of the whale family growing from 1.2 m at birth to approximately 3.5 m and 400 kg at maturity. They are found in temperate waters of the major oceans [1]. In the reported case it is likely that the animal was unable to swim normally due to blunt cranial trauma most likely associated with entrapment and stranding among rocks. The decision to euthanize the whale had been made after a careful assessment of its condition and was performed with the animal removed from the water.

A significant finding at necropsy was filling of the airways with inhaled sand, sometimes with cast formation. This indicated that the animal had inhaled a considerable amount of salt water that contained sand prior to death. This most likely occurred when the whale was struggling in the shallows after being freed, but may also have happened when the animal had been entrapped at high tide in an area of turbulent water that contained significant amounts of sand. Increased amounts of suspended sand may have also resulted from the animal's attempts to free itself. The sand did not enter the airways around or after the time of death as at those times the whale had been removed from the water.

Drowning is a difficult diagnosis to make at autopsy as the pathological findings are nonspecific. Many of the

features that are found in humans who are removed from water, such as 'washerwoman' changes of the hands and feet may merely result from immersion and not drowning [2]. Electrolyte studies have proven non-diagnostic, although elevated blood and vitreous sodium levels are in keeping with saltwater immersion [3].

In the present case sand casts within the airways of an animal that was alive when taken from the water may represent a sign associated with immersion in a particular type of saltwater environment. Although this finding occurred in a veterinary context, there should be no reason why it could not apply to other mammals including humans in similar circumstances. Thus, if formed casts of sand (Fig. 3) are identified within the distal airways of a body removed from the sea, it may indicate that inhalation of water has occurred in surf adjacent to a beach where there is sufficient turbulence to suspend large quantities of sand. While sand may certainly passively enter the airways of floating bodies, this usually consists of a small amount of material adherent to the walls of the airways, not impacted in casts as in the current case. The usefulness of the current case is that the exact location of the animal at all times prior to death was known, enabling correlation of the site of immersion with the necropsy findings. This unusual finding may, therefore, suggest a possible location where salt water inhalation/drowning has occurred.

References

1. American Cetacean Society. Fact Sheet. Pygmy sperm whale *Kogia breviceps*. <http://www.acsonline.org/factpack/PygmySpermWhale.htm>. Accessed 1 Aug 2010.
2. Smith NM, Byard RW, Bourne AJ. Death during immersion in water in childhood. *Am J Forensic Med Pathol*. 1991;12:219–21.
3. Byard RW, Cains G, Simpson E, Eitzen D, Tsokos M. Drowning, haemodilution, haemolysis and staining of the aortic root—preliminary observations. *J Clin Forensic Med*. 2006;13:121–4.